

REMARKS

Claim 1 has been amended to incorporate the subject matter of claims 2 and 3. Claims 2 and 3 have been cancelled. Claims 8 and 12 have been amended to incorporate the subject matter of claims 9 and 10. Claims 9 and 10 have been cancelled. No new matter has been entered by the amendments to claims 1, 8, and 12, and these claims, as amended, are now believed to be in condition for allowance. Claims 4-7, which depend on claim 1, and claim 11, which depends on claim 8, are also believed to be in condition for allowance. Claims 1, 4-8, and 12 have been amended to read “gas fuel” instead of “fuel.” Upon entry of these amendments, claims 1, 4-8, 11, and 12 will remain in the application.

Claim Rejections – 35 USC § 102

In the Official Action, claims 1-12 stand rejected under 35 U.S.C. §102(e) as allegedly being anticipated by Hiraya et al (6,612,294). Applicant respectfully disagrees, because the reference fails to teach or suggest all of the features recited in the claims.

Independent claims 1, 8, and 12 have been amended to include the limitations of dependent claims 2-3 and 9-10, respectively, reciting “a timing with which the fuel is injected from the fuel injection valve into the combustion chamber is immediately before the time for closing the exhaust valve or immediately after the time for closing the exhaust valve.” As fully described in the specification on pages 6, 11-12, and 22-23, the fuel injection valve injects fuel into the combustion chamber before or after the exhaust valve closes — a time when the residual gas has not yet been trapped or pressurized and the pressure inside the combustion chamber is low — so that it is possible to make the fuel injection pressure low. Thus, it is possible to omit a pressurizing device for fuel injection, or if it is provided, the pressurizing device may be of a type just capable of causing fuel to be injected under low pressure.

Hiraya et al teach and claim “a fuel injector directly communicating with the cylinder for spraying gasoline fuel into the cylinder during an exhaust gas retaining duration when the retained exhaust gas undergoes compression.” Exhaust gas retaining duration is controlled by the closing timing of the outlet (i.e. exhaust valve) control device and the opening timing

of the inlet (i.e. intake valve) control device. (see column 7, lines 31-36). Therefore, the duration of the exhaust gas retaining phase is the time between the closing of the exhaust valve and the opening of the intake valve. According to Hiraya (see column 7, lines 19-50), the fuel injector sprays gasoline into in the cylinder when both the intake and exhaust valves are closed during the exhaust gas retaining duration. Hiraya does not anticipate the features of amended claims 1, 8 and 12, because the fuel injection in Hiraya does not occur immediately before or after the closing of the exhaust valve when the pressure in the combustion chamber is low. Therefore, because fuel supply in normal gas engines have low pressure, a system as described by Hiraya et al requires an additional pumping device to inject the fuel into the high pressure combustion chamber. The use of a pumping device adds the complexity of integrating an additional structure and loss of power directed to the pumping device.

In addition, Hiraya et al teach that “inlet and outlet control devices are adjusted to retain exhaust gas for subjecting the exhaust gas to compression” as represented by block 194 in Figure 12 (see column 7, line 65 – Column 8, line 2). Then, the fuel injection of the gasoline is carried out during exhaust gas retaining duration as represented in block 196 in Figure 12 (see column 8, lines 2-3). Hiraya et al do not teach injecting the fuel into the combustion chamber at a timing immediately after the time for closing the exhaust valve when the pressure in the combustion chamber is relatively low. Injecting fuel immediately after the exhaust valve is closed offers similar advantages as injecting fuel immediately before the exhaust valve is closed. By injecting fuel immediately after the exhaust valve closes, the fuel is introduced into the combustion chamber when the pressure has just started to rise and is relatively low. Thus, it is possible to omit a pressurizing device for fuel injection, or if it is provided, the pressurizing device may be of a type just capable of causing fuel to be injected under low pressure. Hiraya et al do not teach such a feature.

Applicant submits that the limitations of cancelled claims 2 and 3, which have been incorporated into claim 1 by amendment, make independent claim 1 allowable. The cited reference does not claim or disclose the claimed features of amended claim 1, and therefore does not anticipate or render obvious the subject matter of claim 1. Also, applicant submits that the limitations of cancelled claims 9 and 10, which have been incorporated into claims 8 and 12 by amendment, make independent claims 8 and 12 allowable. The cited reference

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does not claim or disclose the claimed features of amended claims 8 or 12, and therefore does not anticipate or render obvious the subject matter of claims 8 and 12. Further, applicant submits that claims 4-7, which are all dependent on claim 1, and claim 11, which is dependent on claim 8, are also allowable. Withdrawal of the rejection of claims 1, 4-8, and 11-12 as anticipated by Hiraya et al is thus solicited.

Claim Rejections – 35 USC § 103

In the Official Action, claims 1-12 also stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sato (6,405,695) in view of Hiraya et al (6,612,294). Applicant respectfully disagrees, because the references fail to teach or suggest all of the features recited in the claims.

As stated above, Hiraya et al fail to teach or suggest the features recited in claims 1, 8, or 12 as amended. Sato also fails to teach or suggest the features recited in claims 1, 8, or 12 as amended in that Sato is limited to a valve timing adjuster and does not teach any of the features directed to fuel injection. Accordingly, Applicants respectfully submit that independent claims 2, 8, and 12, as amended, patentably define over Sato in view of Hiraya.

Applicant submits that the limitations of cancelled claims 2 and 3, which have been incorporated into claim 1 by amendment, make independent claim 1 allowable. The cited references do not claim or disclose the claimed features of amended claim 1, and therefore do not render obvious the subject matter of claim 1. Also, applicant submits that the limitations of cancelled claims 9 and 10, which have been incorporated into claims 8 and 12 by amendment, make independent claims 8 and 12 allowable. The cited references do not claim or disclose the claimed features of amended claims 8 or 12, and therefore do not render obvious the subject matter of claims 8 and 12. Further, applicant submits that claims 4-7, which are all dependent on claim 1, and claim 11, which is dependent on claim 8, are also allowable. Withdrawal of the rejection of claims 1-12 as obvious over Sato in view of Hiraya is thus solicited.

CONCLUSION

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The foregoing represents a complete response to the Office Action, and Applicant respectfully submits that claims 1-12 in their present form are in condition for allowance. Early and favorable consideration is earnestly solicited.

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